

THE HYDROACOUSTIC COMPONENT OF AN INTERNATIONAL MONITORING SYSTEM

ABSTRACT

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The critical issue for the hydroacoustic component of an International Monitoring System (IMS) is its capability for monitoring nuclear explosions in the world's oceans. Factors that affect this capability are number and location of hydroacoustic sensors, placement of sensors, blockage of the hydroacoustic signal due to bathymetric effects, and spatial and temporal variation in hydroacoustic signal propagation due to changes in oceanic properties. This paper provides examples of hydroacoustic monitoring capability from historical data that demonstrates the impact of these factors, and discusses implications from these results on design of a hydroacoustic network.

Specific data processing examples of hydroacoustic detection and discrimination capability are given for hydroacoustic signals from earthquakes and explosions recorded at MILS (Missile Impact Location System) and other hydrophones in the Atlantic and Pacific Ocean. In the 1960's, the United States (U.S.) Navy performed a series of ship sinking explosions underwater as well as a set of explosions that traversed the Aleutian Island chain at a ninety degree angle. Another study is of more recent data from a collection of earthquakes south of Australia and in the Southern Pacific Ocean also detected on MILS and other hydrophones. Examples from all of these data illustrate the blockage effects due to the bathymetric profile and effects of hydroacoustic sensor emplacement on the side or top of, or floated from the top of seamounts into the SOFAR channel on hydroacoustic signal strength.

These data processing examples also demonstrate the high degree of confidence achieved in the discrimination between earthquakes and explosions based on their respective frequency content and presence or absence of an explosion-produced bubble pulse signal. The explosion data exhibit significant frequency content up to the anti-alias filter frequency of seventy Hertz, while the earthquake data shows severe attenuation beyond 20 Hertz and no bubble pulse signals. Potential problems are hydroacoustic signals from volcanic explosions that exhibit explosion-like characteristics and from vented explosions or explosions just above the ocean's surface.

The paper recommends that these historical data provide a basis for a knowledge grid of the ocean that would define for each explosion source position (for example, on a 1- by 1-degree grid) what a hydroacoustic sensor would expect to see. The knowledge grid would contain information from both theoretical detection and location capability models and this type of observed historical data. This could ultimately be combined with a similar seismic and possibly infrasonic knowledge grid to give worldwide detection and location capability for subsurface and low atmospheric nuclear explosions. The paper concludes with a design for the hydroacoustic component that takes into account the use of a combination of assets for monitoring nuclear explosions on a global scale that include seismic, infrasonic, and hydroacoustic networks.